

**SURGICAL TREATMENT
OF
DEFORMITIES**

TWO POST-GRADUATE LECTURES

ADAMS

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DEFORMITIES.

I.—ON THE PRINCIPLES OF SURGERY APPLICABLE TO THE TREATMENT OF DEFORMITIES; AND ON SOME RECENT DEPARTURES FROM THESE PRINCIPLES.

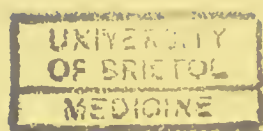
II.—ON THE SURGICAL TREATMENT OF DEFORMITIES DUE TO PARALYSIS.

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SOCIETY; ALSO LATE VICE-PRESIDENT OF THE
PATHOLOGICAL SOCIETY.

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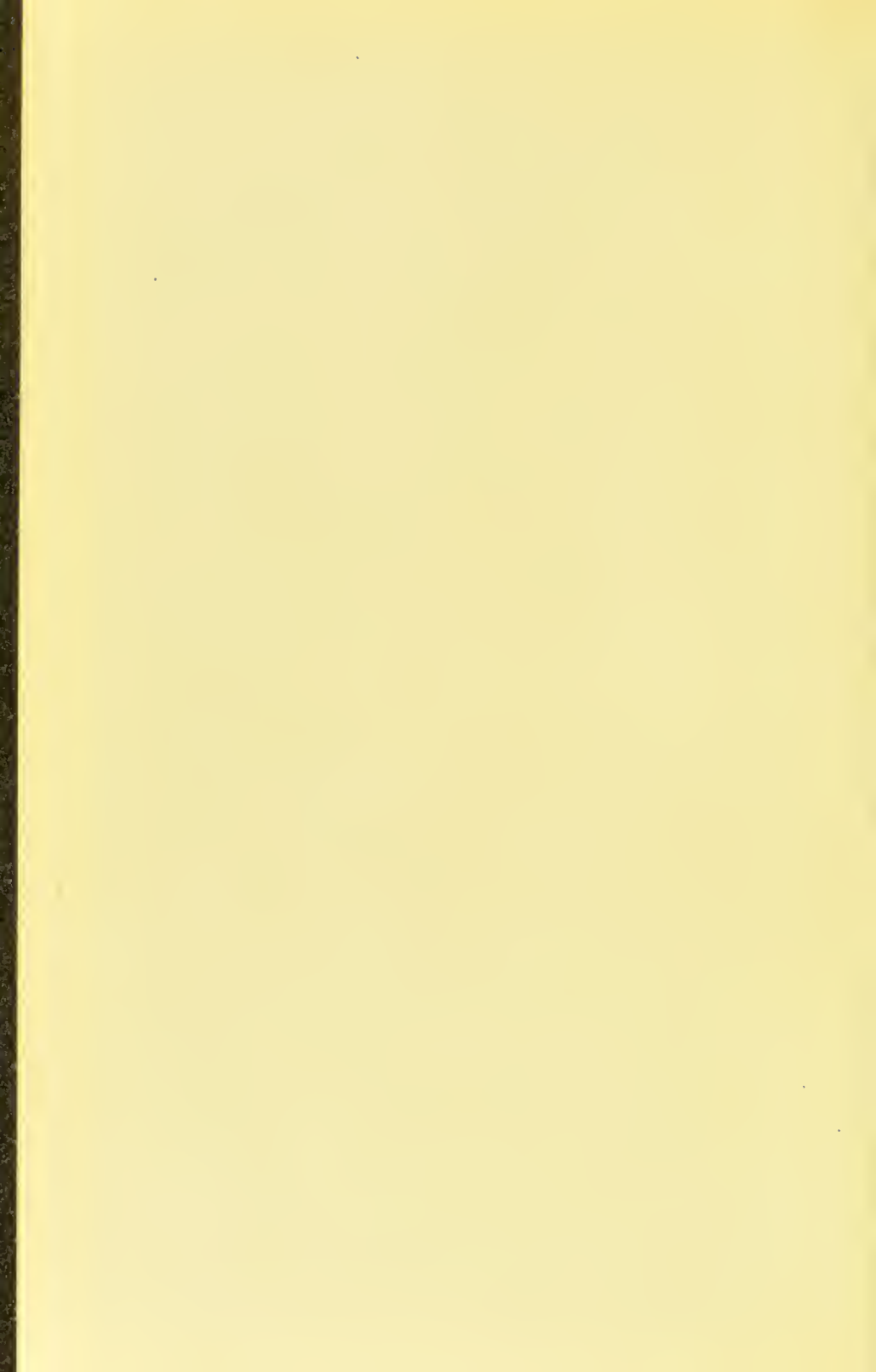
PREFACE.

ALTHOUGH the two Post-Graduate Lectures, published in their present form, have already appeared in print, it has been thought that they might gain a more permanent form, and be more readily accessible if published in a separate pamphlet.

I have the more willingly acceded to this suggestion, because the subject matter has reference to some recent and important changes in practice, and therefore does not appear in my larger works on Orthopædic Surgery.

HENRIETTA ST., CAVENDISH SQUARE,

June, 1893.



LECTURE I.

On the Principles of Surgery applicable to the Treatment of Deformities; and on some recent departures from these principles. (a)

GENTLEMEN,—In the large public institution in which we are assembled to-day—The Central London Sick Asylum—containing as it does nearly 300 beds,—under the care of Mr. John Hopkins, who has kindly given me every assistance, cases may readily be found to illustrate any medical or surgical subject, referring especially to the chronic class of affections; and amongst these I find many cases belonging to contractions and deformities which fall under the observation of those who have more especially studied orthopædic surgery. There are several cases for clinical illustration in the side room, which we may separately examine after the Lecture.

The occasion seems to me, therefore, a fitting one on which I might offer you a few general remarks on the principles of surgery applicable to the treatment of cases of contraction and deformity, more especially as these principles have of late years been subject to many important deviations and modifications in their practical application.

I do not propose to-day to enter into a detailed description of any particular class of contractions, as I am sure with these you are sufficiently familiar. I therefore desire to point out to you the general prin-

(a) Delivered at the Central London Sick Asylum, March 2nd, 1893.

ciples of surgery which are applicable to the various classes of cases into which contractions with deformity may be grouped, and also to advert to the new departures from the established principles of treatment which some surgeons have endeavoured to make.

These general principles of Surgery I have arranged in seven classes, and propose to make some observations on each class, viz. :—

The First Principle.—Mechanical treatment.

The Second Principle.—Subcutaneous tenotomy and gradual mechanical extension.

The Third Principle.—Subcutaneous osteotomy.

The Fourth Principle.—Forcible straightening of bent limbs and contracted joints—"The Bone Setter's" treatment.

The Fifth Principle.—Extension.

The Sixth Principle.—Recumbency.

The Seventh Principle.—Including massage often combined with passive movements and galvanism.

NO. I.—MECHANICAL TREATMENT.

The oldest principle adopted before the treatment of contractions and deformities was brought within the domain of surgery by the introduction of subcutaneous tenotomy in the year 1831, by Stromeyer of Hanover. The mechanical treatment in these early days was necessarily of the simplest kind adopted by a class of so-called mechanicians, and in accordance with the imperfect knowledge of the day. I need only mention the case of the celebrated Lord Byron who was born with a club-foot, and whose sufferings under the mechanical treatment adopted, are well described in Moore's life of the poet, who died in the year 1824,

at the age of thirty-six years. It is a matter of history in the house of the mechanic whose business was conducted in Leicester Square, that on one occasion, in a fit of impetuous temper Lord Byron threw his boot and iron through the window into Leicester Square. The anatomical conditions of this deformity had not then been described, and the mechanical appliances were necessarily ill-adapted to the case.

The same defects necessarily accompanied the treatment of all other contractions and deformities.

NO. II.—THE SECOND PRINCIPLE IS THAT OF SUBCUTANEOUS TENOTOMY FOLLOWED BY GRADUAL MECHANICAL EXTENSION.

The scientific treatment of all contractions and deformities, including both the congenital and the non-congenital forms, when associated with muscular contraction, may be referred to the re-introduction of subcutaneous tenotomy in its improved form by Stromeyer of Hanover, in the year 1831, although Delpech, of Montpellier, had in the year 1816, first suggested the operation, and accurately laid down the principle upon which it should be performed, viz.: the complete exclusion of air, and the after treatment by gradual mechanical extension in proportion to the activity of the reparative process.

Delpech, however, only operated upon one case, and as the result did not prove so successful as was anticipated he never repeated it, and thus sixteen years were lost to the world until Stromeyer re-introduced the operation with essential modifications and improvements in the year 1831.

This improved operation might also have remained

for some time dormant in Germany had it not been for the accidental circumstance of a distinguished member of our profession, Dr. Little, then a student at the London Hospital, and afflicted with a severe degree of contraction of the right foot, going over to Hanover to witness the results of the operation. The favourable impression made upon his mind by the numerous cases he saw, induced him to submit to the operation which Stromeyer performed in 1836 with complete success.

On the 20th February, 1837, Dr. Little first divided the Achilles tendon in London. It is right to say, however, that in this country he had been anticipated by a celebrated English surgeon, the late Mr. Whipple of Plymouth, who divided the Achilles subcutaneously in May, 1836. Mr. Whipple himself informed me that when he first devised the operation he was not aware of its having been performed by Stromeyer, and that Sir Benjamin Brodie, to whom he wrote on the subject, discountenanced it, but Liston sanctioned it on the ground that the chances of benefit outweighed the probability of the patient being injured by its performance.

This is another illustration of the same discovery being made independently in different countries, and sometimes not far from the same date.

In the year 1838 the Royal Orthopædic Hospital was founded by Dr. Little with the aid of rich and grateful patients, more especially Mr. Quarles Harris, whose daughter Dr. Little had cured. At the present time three Orthopædic Hospitals exist in this metropolis.

With the mode of performing the operation and its beneficial results in overcoming all muscular contrac-

tions, whether in congenital or acquired club-foot, contractions of the knee and hip-joint from myelitis and other causes ; contraction at the elbow-joint by division of the biceps tendon ; and in wry-neck by division of the tendons of the sterno-mastoid muscle, you are I am sure sufficiently familiar, and I would merely remark that we always divide tendons by cutting from below upwards towards the skin, whilst in Scotland the Achilles tendon has always been divided by cutting from above downwards ; both Liston and Ferguson advocated this method. I only make one exception to this rule, viz. : when dividing the extensor tendons of the toes and this I always do by cutting from above downwards.

Another point I would advert to is the method of making the cutaneous puncture not directly over the tendon to be divided, but rather more than a quarter of an inch from it, and then carry the knife flatwise under the skin until the tendon is reached, when the direction of the knife must be immediately altered, and the point dipped below the tendon, towards which the edge of the knife must be turned at the same time. This forms an indirect route and more completely excludes the admission of air. When the cut is made from above downwards it is only necessary to turn the edge of the knife towards the structure to be divided, whether tendon, ligament, or a band of fascia, as in Dupuytren's finger contraction, &c.

After subcutaneous tenotomy all contractions and deformities have been overcome by gradual mechanical extension, generally by means of instruments adapted either to the foot, knee, hip, elbow, or neck, and the extension is regulated by one or more of the well-

known rack and pinion movements. This is the old, safe, and successful orthopædic treatment, of the results of which since the Royal Orthopædic Hospital was founded in 1838—more than fifty years—we may be justly proud. My advice to you, gentlemen, would be to keep to the bridge which has carried us safely over. However, new improvements, and some radical changes are being sought after, and I will make a few observations on what I propose to call

THE NEW DEPARTURE from the principle of subcutaneous tenotomy and gradual mechanical extension which we are now considering.

This new departure is divided into two distinct propositions :—

The first proposition is to do away with subcutaneous surgery altogether, and to substitute for it a large open wound with antiseptic precautions, so that the surgeon may see and feel the structure he intends to divide. It is contended that in the subcutaneous method the surgeon is not certain that he divides the structures he intends to divide, and that he runs considerable risk of wounding arteries and large veins,—in fact that the surgeon is operating under a condition of *anatomical darkness*.

The second proposition is to do away with the ordinary mechanical appliances used in the after-treatment so as to regulate the extension as it may appear to be necessary, and to substitute for it the plan of immediate extension, even when the foot, when this method is applied to the foot, should require some force to bring it into its natural position. The foot is then to be retained in its improved position by plaster of Paris bandage, or some other form of immobility splint.

This new departure is of American origin, and first carried out in its entirety, I believe, by Dr. A. M. Phelps of New York, a few years ago. In England Mr. Edmund Owen has for several years carried out this open-wound method with immediate extension, and expresses himself as "highly pleased with it."

Mr. Owen recently brought the subject prominently before the profession in a paper which he read at the Royal Medical and Chirurgical Society of London, on the 22nd November, 1892, on "The Radical Treatment of Severe Talipes Equino-varus in Children."

In this paper Mr. Owen remarks, "the operation recommended in this paper for adoption in severe cases of club-foot is that introduced by Dr. A. M. Phelps of New York; it consists in dividing every resisting structure which is encountered in a free vertical incision passing from the dorsum of the foot into the depths of the sole, over the head of the astragalus, the tendon of the Achilles having been first cut. The improved position of the foot is thus obtained by lengthening the inner border of the foot, rather than by shortening the external border, as is usually accomplished in tarsectomy."

For this new American departure we are therefore indebted to Dr. A. M. Phelps of New York, who must take the responsibility of its results, whether for good or evil, and I am sorry to say that I cannot speak of it in any favourable terms.

With regard to the *first proposition*, the idea of which is that antiseptic surgery has now superseded subcutaneous surgery, I must observe that it is entirely devoid of proof, and I cannot but regard it not only as a retrograde step in surgery, but a very serious

one, as not being without danger to the patient. Subcutaneous surgery has held its own for more than sixty years—*i.e.*, since Stromeyer's operation in 1831. It is based on a sound physiological principle, *viz.*, the exclusion of air, and in its freedom from inflammation, leaves nothing to be desired. In some thousands of tendons which I have divided in more than forty years hospital and private practice, I have never seen inflammation follow the operation, and it is not at all probable that antiseptic surgery with an open wound could have given such a result.

In the larger operations surgeons are by no means agreed as to the value of the antiseptic system. The ovariotomists are by no means agreed, and in my own experience of more than thirty years as surgeon to the Great Northern Hospital, where we adopted Professor Lister's antiseptic method as strictly as our house-surgeons could carry it out, the results were by no means uniformly successful in cases of amputation, removal of breast and other tumours, hernia cases, &c. In all these cases whilst we have had brilliant results in a large number of cases, still a considerable percentage of failures resulted.

Antiseptic surgery, therefore, cannot be implicitly relied upon, as subcutaneous surgery undoubtedly can, and I am convinced that antiseptic surgery will never supersede subcutaneous surgery where the latter can be adopted. There are, moreover, some minor, but still important, disadvantages in the method by an open wound : *first*, the formation of adhesions which is sure to occur, and must interfere with the free movement of the tendons at the end of the treatment ; and, *secondly*, a scar will certainly remain, and it is perhaps

not sufficiently considered that all scars existing in childhood continue to grow *pari-passu* with the growth of the part over which they are placed—for example, I exhibit to you the models of a case of congenital club-foot which was operated upon by open wound in the year 1851 by a surgeon of Bradford, in Yorkshire, who dissected off the redundant skin on the convexity of the foot, with the idea of obtaining contraction on the outer side. When this child was brought to me in October, 1852, he was nearly two years old, and the scar on the convexity of each foot measured two inches and a quarter in length, but it was of a linear character. When he came a second time under my care in May, 1859, in consequence of a slight degree of relapse, it was found that each scar had grown fully an inch in length during the six years and a-half. Casts of the feet were taken on both occasions, and I exhibited them to the Pathological Society on the 21st February, 1860 (see vol. xi.).

The second case in which I had the opportunity of watching the growth of a cicatrix occurred in a little girl about a year old, and a cousin of my own, who was the subject of a prominent and rapidly-growing *nævus* situated between the clavicle and the right nipple, rather nearer to the latter. My former master, Mr. Jos. Henry Green was consulted by my father, and he decided to remove it, remarking that as the incision would only be about an inch and a-half in length, the scar would be of no importance. Mr. Green performed the operation at which I assisted, and, as he knew the incision would be deep and he wished to avoid hæmorrhage, he remarked when commencing the incision, "Now then, quick is the word"; probably

this was the only occasion on which Mr. Green ever used such an expression, as he was notoriously a very slow operator.

This young lady grew up as a fine stout girl, and with the general growth and expansion of the breast the cicatrix not only grew in length but also in width, so that at the age of eighteen years it measured three inches in length, and varying from three quarters of an inch to one and a half inches in width, and the thin cicatricial tissue had a marked tendency to become red, so that a low dress never could be worn. This cicatrix was traced for me on silver paper by her sister, and I exhibit it to you. I described this case in a paper "On the Growth of Cicatrices in Childhood" I read before the Medical Society of London, 17th Nov., 1873. (a)

In the foot a cicatrix might not be considered to be of any importance, though a gentleman in the position of my first case regarded it with a good deal of disfavour, but in other situations it should be avoided in children. This remark would especially apply to the sterno-mastoid muscle which Mr. Owen has advised should be divided by open wound in his Lettsomian Lectures at the Medical Society of London, in January and February, 1890. There can be no doubt that a young lady of twenty years of age would not like to see a large transverse scar across her neck, where the sterno-mastoid muscle had been divided in childhood for wry-neck.

Then with regard to the division of such articular ligaments as are within reach of the surgeon, as for

(c) See "Proceedings of the Medical Society of London," vol. i, p. 105.

example the ligamentous bands passing between the navicular bone and the astragalus on the inner side, which can easily be reached after the anterior and posterior tibial tendons have been divided—an operation first proposed by my friend Mr. Parker, which certainly helps to liberate the navicular bone in severe cases. Also the inner band of the deltoid ligament can be easily reached and divided. The strong calcaneo-cuboid ligament can easily be divided by a puncture on the outer side of the foot, and this operation I have done for many years in cases now described by my colleague, Mr. Fisher, as *talipes arcuatus*, *i.e.*, when the anterior portion of the foot is flexed from the transverse tarsal joint so as to shorten the sole of the foot, and raise the arch to an unnatural extent.

Nor can I at all agree with the remark made by Mr. Owen that in subcutaneous operations the surgeon operates “comparatively in anatomical darkness,” so that he cannot know for certain what structures he is dividing. With the tendons nearly always superficially placed, so that they can be either seen or felt, and the landmarks for the division of the deeply seated posterior tibial tendon and other structures clearly laid down, it seems to me that a careful study of the anatomical condition of the parts involved, together with a little experience and a cultivated touch, always necessary in subcutaneous operations, are all that is required to enable any surgeon to perform these operations subcutaneously.

This, gentlemen, completes the objections I have to raise against *the first proposition* involved in this new departure from the long established rules of practice and I will now proceed to make a few observations on

the second proposition, the idea of which is to do away with the ordinary mechanical appliances used in the treatment to regulate the extension, and to substitute for it the plan of immediate extension and rectification of the deformity. When applied to club-foot this principle is recommended, even if the foot should require some force to bring it into its natural position. The foot is then to be retained in the improved position by plaster of Paris bandage, or some form of immobility splint.

Of this proposition I can only say that it is very unscientific as opposed to our knowledge of the reparative process in tendons, and not without risk of serious injury to the patient by interfering with the reunion of the divided tendon. If this should occur in the Achilles tendon, so that the uniting medium is thin, elongated, and imperfect, the patient will be proportionately damaged, and an opposite and incurable deformity—*Talipes calcaneus*—is sometimes produced. I exhibit to you a drawing of a case in which this occurred in both feet of a young lady. I always watch the reparative process in a divided tendon, and examine it once or twice a week for three or four weeks, at which time the divided extremities of a tendon generally begin to form a junction with the new reparative material thrown out between the divided extremities.

The reparative process is sometimes rapid, especially in young healthy children ; sometimes it is sluggish and imperfect in children of delicate constitution, and at other times the new material thrown out between the divided extremities of the old tendon is very thin and attenuated, more especially in cases of contraction

due to paralysis, either infantile or adult. A few weeks ago I took Mr. Noble Smith to see a young lady, æt. 23, whose Achilles tendon I had divided more than a month previously, for a severe contraction following an attack of paralysis two or three years ago. In this case about one and a half inches of new material was required, but only an inch at the upper part had formed. A gap of half an inch existed at the lower part, and the lower fragment of the tendon still presented a square and abrupt outline. This was a case of retarded union, but it is now fairly perfect and she has begun to walk with a stop-joint at the ankle to prevent undue flexion.

Immediate extension applies only to the division of fascia and ligaments, as we do not wish these structures to reunite ; but it never should be applied to the division of tendons, the reunion of which is one of the chief points to be attended to in the after treatment.

These are my objections to *the second proposition* as regards immediate extension and fixation in the new departure.

Now, gentlemen, although only dealing with the general principles of surgery applicable to the treatment of contractions and deformities in the present lecture, and avoiding details it may be worth while calling your attention to one of the general rules of practice in the treatment of club-foot to which I have especially drawn attention and followed for many years.

It has not been sufficiently considered that the foot in all its deformities moves from two very distinct centres of motion, viz., *first* from the transverse tarsal joint which, partaking more or less of the ball-

and-socket type, controls the movements of inversion, flexion, and rotation of the anterior two-thirds of the foot in varus, and eversion in valgus ; and *secondly* from the ankle-joint which, belonging to the ginglymoid type, admits only of flexion and extension by the elevation or depression of the os calcis.

The rule of orthopædic practice has therefore long been in severe cases to divide the treatment into two stages, the object of the *first stage* being to overcome the more complicated movements from the transverse-tarsal joint, and when this has been accomplished and the foot brought into a straight line with the leg ; then in a *second stage* to divide the Achilles tendon and restore the flexion and extension movements at the ankle-joint. In the first stage the fixation of the os calcis by the contraction of the Achilles tendon is found to be of the greatest advantage, and a sufficient reason for delaying its division.

If I have been more successful than some surgeons in the treatment of severe cases of club-foot, and cases of relapsed club-foot after others have failed, it is only because for more than thirty years I have rigidly adhered to the above principle of treatment which I laid down after dissecting a number of club-feet, and more especially after studying the anatomical conditions in a carefully dissected and dried specimen of adult varus, which fortunately I was enabled to purchase in the year 1853, and of which there are three illustrations in my work on Club-foot, Figs. 34, 35, and 36. This specimen which at the time I believe was the only reliable dissection of an adult club-foot in this or any other country, is now in the museum of the Royal College of Surgeons.

I was thus led to attach a much greater degree of importance to the transverse-tarsal joint than it had hitherto received ; and it so happened that early in 1854 a case of severe adult varus in a gentleman, æt. 26, came under my care, and I had a new instrument, represented in Fig. 56 in my club-foot book, especially constructed for him, and moulded upon the dissected leg referred to. This instrument was radically opposed to all the instruments previously in use but in about a year and a quarter the foot was completely restored to a natural position as shown in Figs. 94, 95, and 96 in my work referred to. The only drawback was a limited degree of mobility at the ankle-joint which would be expected from the age of the patient, but a gradual improvement in this respect took place, and the result was extremely satisfactory.

I would, therefore, strongly recommend you to follow the same principle of treatment, whether in infantile or adult varus, and not to be led into the error of dividing all the tendons at once and immediately attempting to overcome the deformity by force, and afterwards fixing the limb in an immobility splint.

There can be no doubt that this orthopædic treatment is necessarily slow, tedious, and troublesome, always taking seven or eight weeks in the infant and as many months in the older children, and a year or more in some cases of extreme severity, but it leads to the foot being not only perfectly restored in form but physiologically perfect as regards all the natural movements from the two great centres of motion to which I have directed attention. This may, therefore, very justly be considered as one of the triumphs of modern surgery.

I now pass on to the consideration of another principle of surgery of modern origin, mentioned as the *third principle*, especially applicable to the treatment of many contractions and deformities :—

No. III.—OSTEOTOMY.

Next to the discovery of tenotomy with all its valuable, or I would rather say invaluable, results, came more gradually the idea that the bone might be cut through with advantage in many cases of deformity and distortion, either by the subcutaneous method or by open wound.

A solid approach to the true subcutaneous osteotomy was made by the celebrated German surgeon Langenbeck, (a) who during the Schleswig-Holstein War of 1848 first introduced the use of a small-pointed saw, with a point one-eighth of an inch wide, gradually increasing to half-an-inch at the base, the intermediate cutting edge being four inches in length. With this saw exposed portions of bone were removed in suppurating wounds, and then Langenbeck remarks in his work published in 1854, the idea of resection of bones dawned upon him. Cases of bony ankylosis of the knee-joint, and ricketty deformities were operated upon, a drill in the shape of a gouge a quarter of an inch in diameter being first used, and the pointed saw then introduced.

Operations, generally for ankylosis of the knee-joint, or ricketty deformities, were performed in this country, in Germany, and in America, the gimlet or small chisel being used to weaken the bone before forcibly breaking it.

(a) "Subcutane Osteotomie." Von B. Langenbeck, M.D. Berlin. 1854.

A great impetus was given to *subcutaneous osteotomy* in this country by the operation of the subcutaneous division of the neck of the thigh bone, which I first performed at the Great Northern Hospital on Dec. 1st, 1869. (a)

The patient, Luke Bristowe, æt. 24, was a gardener, and seven years previously had suffered from a severe attack of rheumatic fever. The right leg was drawn up and the thigh flexed at a right angle with the pelvis, and the limb abducted. He could only walk with crutches or one crutch and a stick. All attempts to break down adhesions by forcible extension by myself and colleagues failed, and the case was considered to be one of bony ankylosis.

It occurred to me that a division through the neck of the thigh bone was the only surgical procedure to relieve such a severe contraction, and I thought this might be done subcutaneously if I could only get a saw small enough and strong enough for the purpose. To obtain this saw was my only difficulty, and this after many experiments on bones and hard woods was accomplished by my talented instrument-maker, Mr. Blaise, of Savigny & Co., St. James's Street. A wide double cutting edge, an inch and a half in length for an adult, was found to be necessary, the blade, three-eighths of an inch in width, gradually becoming thinner towards the back, at the end of a slender shank. somewhat flattened and rounded, and measuring three inches in length. This allowed for the saw being carried to the requisite depth without interfering with

(a) "A New Operation for Bony Ankylosis of the Hip-joint with Malposition of the Limb, by Subcutaneous Division of the Neck of the Thigh Bone." By Wm. Adams, F.R.C.S. J. and A. Churchill. London. 1871.

the cutaneous puncture made by an enlarged tenotomy knife three-eighths of an inch in width.

No difficulty was experienced at the operation ; no inflammation or deep suppuration followed. The contracted muscles at the hip were divided at the time of the operation, and the leg was bandaged in a straight position to a long interrupted Liston splint. In a fortnight I began to encourage motion, but all attempts at movements were so painful, that I gave up the idea, and the result was bony ankylosis in a straight position with a good useful leg. Weight extension was used when the straight splint was discontinued.

This operation has been repeated many times by myself and other surgeons in this country and America. It is now a well-known and generally adopted operation. Saws of a smaller size with a cutting edge of one inch and an inch and a quarter in length, are used for younger people, and these I exhibit to you. Mr. T. Bryant, of Guy's Hospital, successfully applied it to a number of cases of fibrous ankylosis after hip-joint disease arrested in an early stage, when the ankylosis would not readily yield to a little force. Mr. P. Pick, of St. George's Hospital, also followed the same course.

The selection of cases is no doubt a matter of importance, the most favourable being those in which the ankylosis has followed an attack of rheumatic fever, as no destruction of bone occurs in this class ; and the most unfavourable are those in which the ankylosis has resulted from hip-joint disease, with chronic suppuration, and more or less, destruction of the head and neck of the bone. In these cases the division through the neck should not be attempted. Fortunately an admirable suggestion was made by my friend, Mr. F.

J. Gant, to divide through the shaft of the femur just below the small trochanter, and I was present when he first performed this operation on the 10th December, 1872. No difficulty was experienced, and the case did remarkably well. I have applied this subcutaneous osteotomy to the division of the shafts of the long bones in many cases, generally of badly united fractures with malposition, or of severe rickety curvatures. The results have been extremely favourable.

A very bold, and decidedly the most ingenious application of the subcutaneous saw, was made by Professor Alexander Ogston, of Aberdeen, who proposed in cases of severe knock-knee to introduce the saw just above the inner condyle of the femur through a tenotomy puncture, opening the capsular ligament, and then carry the point obliquely downwards towards the median line, between the condyles. By the use of the saw the inner condyle can now be readily detached, the bone between the condyles being very thin. The detached inner condyle is then to be pushed upwards by a lateral movement of the head of the tibia, and a straight splint applied. Passive motion should be commenced at the end of the third week ; occasionally at the end of five or six weeks some bands of adhesion may have to be broken through, but under the subcutaneous system no inflammation of the joints seems to occur. I adopted this operation some years ago at the Great Northern Hospital in a severe case of knock-knee in a young adult, æt. 23, and the result was extremely favourable, the deformity being cured without the free motion of the joint being at all interfered with. I doubt whether this operation is generally applicable to children, but after the completion of growth it may be recommended.

Professor Ogston's operation seems, however, gradually to have given way to the operation adopted by Professor Macewen, of Glasgow, who, in cases of knock-knee, divides the femur a little above the knee-joint with a chisel, and in his hands this instrument has been extremely successful, but still it always appears to me that the subcutaneous saw is much more reliable as an instrument of precision, and more manageable, without the risk of accidents.

Osteotomy performed by open wound is an operation of much older date, and the American surgeons led the way in operating on cases of ankylosis of the hip-joint with the object, not only of correcting deformity, but of obtaining motion by the formation, more or less, of a new socket. In the year 1826, Rhea Barton, of Philadelphia, successfully divided the femur transversely by a fine saw, just above the trochanter minor, through an incision, made over the great trochanter, seven inches in length, and five inches in a horizontal direction. It is said that useful motion was obtained, but that seven years afterwards ankylosis took place. (a)

In the year 1862 Professor Sayre, of New York, revived this operation with some modifications, and operated upon two cases. The operation consisted in the removal of a transverse section of the femur, with a convex upper surface, just above the trochanter minor, by means of a chain saw, an incision of about six inches in length being made over the trochanter major.

(a) "On the Treatment of Ankylosis by the Formation of Artificial Joints," in the *North American and Surgical Journal*, April, 1827; with further remarks in the *American Journal of Medical Sciences*, vol. xxi.

The first case, a man, æt. 26, did very well, and obtained a good, useful limb, but whether motion was retained is not stated. The second case was less favourable. The patient was a girl, æt. 24, and deep suppuration occurred, with the escape of a little necrosed bone ; pneumonia and pleurisy also occurred, and she died six months afterwards. Tubercular deposits were found in the lungs, and a large abscess in the left lung. The formation of an artificial joint is stated to have been proceeding very favourably, the articulating surfaces being tipped with cartilages. I am not aware of any other operation of this nature having been performed with the object of obtaining free motion by the establishment of an artificial joint in which articular cartilage and synovial membrane are reproduced.

In the class of cases we are now describing excisional surgery, sometimes applied to the treatment of deformities, as well as cases of progressing disease, must hold a place. Many years ago I excised the head of the humerus, at the Queen's Square Hospital, in an old unreduced dorsal dislocation, and restored free motion with a useful arm. In the year 1882 (a) I also excised the head of the femur, at the Great Northern Hospital, in an unreduced dislocation of long standing, after repeated attempts at reduction by the ordinary means had failed. The dislocation occurred spontaneously during fever ; and in this case also I restored free motion with a useful leg. The head of the bone is preserved in the Museum of the Royal College of Surgeons. This operation was first performed by Dr.

(a) Proceedings of the Royal Medical and Chirurgical Society, Oct. 28th, 1834.

H. G. Rawdon, of Liverpool, in the year 1881, (a) and both the children, æt. about 11 or 12, were exhibited at the Medico-Chirurgical Society, on the 28th Oct., 1884.

Excision of the knee-joint for bony ankylosis with malposition of the leg, I have also performed, and operations of this class have been done by many surgeons.

In the treatment of severe cases of congenital club-foot, especially in cases of talipes varus occasionally seen in young adults, and in relapsed cases at younger ages, osteotomy by open wound has been frequently performed with considerable success. The foot has been brought into a fairly natural position, and restored to usefulness, but I need hardly say far short of physiological perfection, the motion at the ankle-joint generally remaining very limited. The best result I have seen was obtained by Mr. Lund, of Manchester, after excision of the astragalus.

Excision of the cuboid bone was first suggested by Dr. Little, but the operation was first performed by the late Mr. Samuel Solly, of St. Thomas' Hospital on the 26th June, 1854, and by whose invitation I was present, but was not consulted regarding it. Dr. Little and several surgeons were also present. The operation was performed by making a free incision over the convexity and the outer margin of the foot, exposing the cuboid bone, which was then removed piece-meal by the gouge, but portions of other bones were also cut away. The object was to remove a large wedge from the convexity of the foot. The immediate

(a) *The Liverpool Medico-Chirurgical Journal*, Jan. 2nd, 1882.

effect of the operation was to produce some improvement in the position of the foot when this was forcibly everted, but the after treatment was troublesome, and the result of the case less successful than anticipated by Mr. Solly. The patient was a young gentleman, æt. 21, who came to this country to be cured of severe congenital varus.

This operation has been frequently performed during the last ten years or more, by my friend, Mr. Richard Davy, of the Westminster Hospital, with some modifications; and also by Mr. H. L. Ewens, of Clifton. The cases selected have been extremely severe, and the results on the whole very satisfactory. I have never had occasion to perform this operation in private practice having always succeeded in curing these cases up to 26 years of age; and in the Orthopædic Hospital, when these severe cases are admitted, sufficient time—say a year—is allowed for the more gradual method which I have described. I think, however, the ultimate result would be improved in these cases of osteotomy, if the treatment were divided into two stages, the osteotomy being limited to the first stage, as a rapid means of everting and unfolding the foot which should be brought into a straight line with the leg. Then in the second stage the Achilles tendon might be divided and the foot uplifted by the use of the simplest form of Scarpa's shoe.

I have now, gentlemen, to say a few words upon another principle in General Surgery especially applicable to the treatment of many cases of contractions and deformity—the fourth of my series, viz. :—

NO. IV.—FORCIBLE STRAIGHTENING OF BENT LIMBS
AND CONTRACTED JOINTS; AND FORCIBLE MOVE-
MENT IN THE TREATMENT OF STIFF JOINTS.

Badly united fractures in the long bones have always been forcibly rebroken and set by the "bone-setters," and hence the general term applied to this method of treatment is "bone-setting" or the bone-setter's treatment, but the introduction of subcutaneous osteotomy has rendered this practice obsolete.

Many years ago I saw M. Guérin, of the Hotel Dieu in Paris, forcibly straighten a rather severe case of knock-knee in a patient of my late colleague, Mr. John Gay, at the Great Northern Hospital. More force had to be employed than I had ever seen used, the surgeon's knee being placed on the inner side of the knee-joint to act as a fulcrum, and with one hand on the femur, and the other on the leg, all the force the surgeon was capable of using had to be employed before an audible snap took place. The object was to obtain a partial separation of the epiphysis of the thigh bone. The leg was immediately straightened and a straight splint applied. The case did well.

In the year 1861, it occurred to me that this principle of forcibly straightening, or re-breaking badly united fractures might be applied to broken noses which occasionally came under the notice of the surgeon.

On the 12th July, 1861, a young gentleman, L. L., æt. 16, who had sustained an injury to the nose from a cricket-ball at Eton a month previously, was brought to me by his father, in consequence of opinions which had been given by the local surgeon at Eton and two London consultants, that no surgical measures could improve the condition of the nose; and if improved, it

could not be maintained. The late Sir Prescott Hewitt, who generally attended the family, advised that nothing should be done, and in this the other surgeons agreed. The external deformity was slight, consisting of a depression a little above the tip of the nose, from the junction of the cartilage with the bone, with a lateral inclination of the anterior portion. Since the accident, however, the voice had become completely altered, and assumed a most disagreeable nasal twang, and the breathing through the right nostril was obstructed. This was the cause of great anxiety in the family as the father very quietly observed "we think very little of the deformity as all our noses and little fingers are crooked," but the loss of voice to a man destined to hold a public position was a serious matter.

On examination I found the right nostril obstructed, or I might say completely occluded, by the cartilaginous septum which had been bent, and probably broken, by the blow from the cricket ball, and now projected into the cavity of the right nostril, so that a probe could not be made to pass through it, nor could air be made to pass by efforts at inspiration or expiration. The cavity of the left nostril was much enlarged by the depression and bending of the cartilaginous septum into the right nostril. No fracture of the nasal bones could be detected, though a little bending at the free border might exist ; there was no depression or lateral displacement of the nasal bones.

Considering all the circumstances of the case, I advised that an attempt should be made to straighten the septum, and retain it in the improved position by some mechanical appliance ; and consent being at once given by the father I directed Mr. Blaise, of Savigny's

in St. James's Street, to prepare the strong flat-bladed forceps, the clamp and ivory plugs.

On the 16th July, 1861, the first attempt to straighten the septum was made, with only partial success, in consequence of the patient not being allowed by his father to take chloroform, and the pain and sneezing rendered it impossible to proceed. The clamp was, however, worn for three days and three nights, and afterwards the ivory plugs were used. This did not cause much pain or inconvenience, and the improvement was very decided, although incomplete. Consent to the administration of chloroform was now obtained, and on the 30th July I repeated the operation, the chloroform being administered by Dr. Allan, the medical attendant of the family. I now completely straightened the septum, and all the obstruction of the right nostril was removed, so that the forceps, with the blades closed, could readily be passed through it. The retentive apparatus was used as before, the ivory plugs being worn at night for several weeks. It was not necessary to repeat the operation; the external deformity was removed, and the voice was completely restored. At the present time (1893) this gentleman's voice is clear, and distinctly to be heard in any large assembly. (a)

I have given this case somewhat in detail because it was the first in which any such operation had been performed, but now it has become an established surgical procedure, described in every text-book, and the instruments used are generally figured. I exhibit to you to-day all the latest alterations and improvements in the clamp, and the plugs, and also the narrow

(a) *Brit. Med. Jour.*, Oct. 2nd, 1875, and "Proceedings of Medical Society of London," vol. ii (1874 and 1875).

curved forceps to raise the nasal bones and straighten the central plate of the ethmoid bone. There is also another form of retentive apparatus which I have found necessary in severe cases, when the nasal bones are fractured, depressed, and displaced sideways. It is described as a nose truss, and consists of a steel band passing round the forehead, with a steel plate in front, to which two movable levers with felt pads are attached—one long and one short lever; the short lever is intended to support the convexity of the curve after the fractured and displaced nasal bones have been raised, and the long lever acts as a counter-pressure lower down. I first employed this instrument in a very severe case upon which I operated on the 9th June, 1871, and have frequently used it since.

As a part of the principle of forcibly straightening bent limbs and contracted joints, I would make a few remarks with reference to the application of this principle in cases of contracted joints and also in cases of stiff joints.

1st. The cases of a traumatic origin are the most favourable for this treatment.

2nd. Cases of a rheumatic origin are also very favourable.

3rd. Cases of a strumous origin are the most unfavourable.

4th. Cases of muscular contraction, such as infantile or adult forms of paralysis are very unfavourable, and always yield to tenotomy and gradual mechanical extension.

5th. Cases of deformity such as talipes varus and valgus have been treated upon this principle, but nothing can be more unscientific than to tear through,

or attempt to tear through the normal articular ligaments of any joint, as they will all yield to gradual mechanical extension. (a)

The next general principle in surgery, the fifth of my series, to which I would direct your attention as especially applicable to the treatment of deformities and contractions is

NO. V.—THE PRINCIPLE OF EXTENSION.

This is undoubtedly one of the most important principles of modern surgery, and for it we are indebted to the genius and practical ability of the American surgeons.

It was first discovered in connection with the treatment of hip-joint disease in about the year 1850 by Dr. Henry G. Davis, of New York, who found that extension by the weight-and-pulley apparatus relieved the pain and overcame the contraction in hip-joint disease. As a remedy for the acute pain met with in some cases of hip-joint disease in the early stage, I need hardly say that this was an invaluable discovery, and it applies equally to the knee and the ankle-joint. It also led to the explanation of the pain being due to a mechanical cause, *i.e.*, articular pressure caused by the contraction, and not to the acuteness of the inflammation as formerly supposed, all active anti-phlogistic treatment therefore being done away with.

Dr. Henry Davis continued his observations, and in

(a) This principle in surgery was fully discussed in the Section of Surgery at the Annual Meeting of the British Medical Association in Worcester, on the 9th August, 1882, under the head of "Bone-setting." The very able introductory address by Mr. Howard Marsh, followed by a paper by Mr. Adams "On the Selection of Cases," are reported in the *British Medical Journal*, 7th October, 1882.

the year 1855 (a) invented a hip-joint instrument by which the patient, when the acute stage had subsided, was enabled to walk whilst the extension was still maintained. Thus extension with locomotion was another great advance in treatment.

About the same period Dr. Louis Sayre, of New York, also directed his attention to the influence of extension in relieving pain and overcoming contraction in disease both of the hip and knee-joint. With the object of combining extension with locomotion, Dr. Sayre invented an instrument in a greatly improved form, now well known as "the American hip-joint instrument."

In the year 1860 Dr. Gurdon Buck, of New York, applied the weight extension principle to the treatment of fractures of the femur and of the leg. Dr. Joseph Pancoast, of Philadelphia, and Dr. Grosse also advocated this system which English surgeons have adopted for many years.

Extension by the head and arms with the patient in a standing position has been used by Dr. L. Sayre in the treatment of lateral curvature of the spine as a preliminary to the application of the plaster of Paris jacket which is intended to preserve the improved position gained by extension.

Dr. Sayre also adopted the same plan in the treatment of Pott's disease of the spine, sometimes suspending from the head only as a preliminary to the application of plaster of Paris jacket.

In these cases, however, I prefer absolute recum-

(a) "Conservative Surgery," by H. G. Davis, of New York. Appleton & Co., New York, 1867.

bency for about two years, with the application of a poro-plastic felt jacket for support and immobility.

Extension by the head only, combined with absolute recumbency I have found to be very valuable in cases of Pott's disease in the cervical and upper dorsal regions, especially when associated with more or less paralysis. The paralysis begins to improve in a few days and disappears in a few weeks. The patient must be on a movable plane, to which a rack and pinion movement is attached for regulating the extension, and in the day-time it can be placed in a spinal carriage, so that the patient may pass as much time as possible in the open air.

Extension applied to both legs with counter-extension by the head and arms I have found to be very useful in some cases of fractured spine in which the displacement of the vertebræ is not sufficient to cause complete paralysis. A very successful case of this kind occurred in my practice at the Great Northern Hospital many years ago. A plumber fell about twenty or thirty feet from a ladder and fractured his spine. When he was admitted partial paralysis existed in both legs, and an angular projection of the twelfth dorsal or first lumbar spine was very distinct. I commenced the extension treatment, the patient being kept on a fracture-bed covered by a thin mattress. The paralysis diminished somewhat rapidly at first, and then completely, so that the extension was discontinued in about three months. The recumbency was continued for two or three months longer, and in about six months from the accident he was discharged, wearing a steel spinal support. He gradually resumed work and came to see me at the hospital, but he wore the spinal support for more than a year.

Extension applied to both legs, with counter-extension from the pelvis, applied to cases of congenital displacement of the hip-joint, generally, but erroneously described as "congenital dislocation," of the hip-joint.

The last application of the extension principle was made by a distinguished American surgeon, Dr. Buckminster Brown of Boston, in the year 1882. (a) In April, 1882, a little girl, four years of age, was taken to Dr. Brown who at once recognised the case as one of double displacement of the hip-joint. From his experience he advised against all active treatment, and Dr. Brown had studied this affection in Paris as early as 1845 and 6, in the wards of M. Guérin in the "Hôpital des Enfants Malades." The parents, however, urged Dr. Brown to try some means of relief, and he decided upon a long course of extension upon the weight-and-pulley system which was commenced on the 30th December, 1882. On the 14th January, 1884, the little girl sat up in bed for a short time, and soon after this attempts at walking in a go-cart were commenced. On the 2nd January, 1885, [the report says "the child walks well without canes." The photographs, taken two years and three months after the commencement of treatment, show an improvement far beyond anything that could have been anticipated.

When this case was published I saw at once the value of this principle of treatment, but endeavoured to modify the apparatus by making the extension on a movable plane so that the patient could be moved about easily and taken into the open air in a spinal

(a) "Double Displacement of the Hip." By Dr. Buckminster Brown, Boston, U.S. Cupples, Upman & Co. 1885.

carriage. This Mr. Ernst very ably contrived for me by attaching the extension and counter-extension straps to the movable plane. I have carried out this treatment in a number of cases, and the results have been very satisfactory. They will shortly be published. Two papers of mine on this subject have already appeared in print. (a) (b)

The next general principle in surgery, the sixth in my series, on which I have only a few remarks to make is that of recumbency.

NO. VI.—RECUMBENCY.

The older surgeons used to rely upon recumbency to a much greater extent than is adopted at the present day. In the treatment of lateral curvature of the spine the order was frequently given for young ladies to lie down for two years ; and in Pott's disease of the spine a similar order was generally given. In the latter affection I still adhere to absolute recumbency, but in lateral curvature partial recumbency at an angle of 45° for four or six hours a day is sufficient, in combination with gymnastics and the patient wearing a light spinal support. In the treatment of congenital displacement at the hip-joint, to which I have just referred, I always order absolute recumbency for at least two years, and in children I have never known the health suffer.

Before concluding, I must refer to another, and the last principle of treatment, the seventh in my series, applicable to many cases of contraction and deformity, viz. :—

(a) *The British Medical Journal*, April 23rd, 1887.

(b) *Ibid.*, Feb. 22nd, 1890.

NO. VII.—MASSAGE OFTEN COMBINED WITH PASSIVE
MOVEMENTS AND GALVANISM.

I need hardly say that this treatment now holds a high position, owing to the influence of many well-known authorities who have devoted their attention to these subjects, and to no one are we more indebted than to our friend Dr. J. Fletcher Little, the able secretary of this "Post-Graduate Course." Through Dr. Little's teaching a sound and reliable knowledge of these subjects is rapidly becoming more generally known. In cases of infantile paralysis and of muscular wasting I am constantly seeing great advantages from this method of treatment ; generally massage and galvanism in combination, and frequently also with the addition of passive movements.

Now, Gentlemen, I have brought before you seven well recognised principles in surgery which are especially applicable to the treatment of contractions and deformities, and in so doing have alluded to the serious consequences which may result when these well-established fixed principles are departed from by those who run after novelty.

Each principle, with its history and illustrations, might well form the subject of a separate lecture in a course of orthopædic lectures, but to-day I have endeavoured to sketch the general principles in outline, and mention the cases to which each principle is especially applicable, and in this general survey I trust that some of you will find the materials for extending the work.

LECTURE II.

ON

THE SURGICAL TREATMENT

OF

DEFORMITIES DUE TO PARALYSIS.^(a)

GENTLEMEN,—At this hospital, especially devoted to the treatment of patients suffering from epilepsy and paralysis, unusual opportunities are afforded for studying these affections in all their varieties. These cases are generally presented to you in their *medical aspect*, and the great advances both in diagnosis and treatment made by my distinguished medical colleagues have been well recognised by the profession. But there is also a *surgical aspect* presented by many of these cases, some of which can be relieved by such operations as trephining the skull and removing any tumour or morbid growth from the substance of the brain which had been diagnosed, and also the operation of trephining the spine, either for the relief from pressure produced by fracture, causing paralysis, or the removal of any

(a) Delivered at the National Hospital for the Paralysed and Epileptic, on June 12th, 1890.

morbid growth. These large operations, performed with strict attention to the rules of antiseptic surgery, have been the special study of my colleague, Mr. Victor Horsley, and the results obtained stand out prominently amongst the advances made in modern surgery.

But besides these large operations, there yet remain a considerable number of cases of paralysis in which we have to deal surgically with the late effects—more especially with contracted joints and distortion of limbs,—and the treatment of these cases falls more or less under the observation of those who have gained some knowledge of orthopædic surgery.

It is this class to which I desire to direct your attention to-day, as the surgical treatment of these cases presents some points of special interest. As a general law, all paralytic affections of the upper and lower extremities, whether infantile or adult, have a tendency to pass into a state of contraction, with some malposition or deformity at the joint or joints involved; whether the hip, knee, ankle, or transverse tarsal joint in the lower extremity; or shoulder, elbow, or wrist in the upper extremity. The muscular affection of the eyes, in cases of paralysis producing strabismus, need hardly be alluded to by me, as they fall especially under the observation of the ophthalmic surgeon attached to the hospital.

The contractions met with in the upper and lower extremities naturally arise as the result of the loss of the balance of muscular power, as we know that in many of these affections, especially in the Infantile class, either individual muscles or groups of muscles are chiefly affected. We also know that the recovery

of muscular power proceeds at very unequal rates in different muscles, or groups of muscles ; for example, the deltoid muscle is always very slow to recover, and often fails to do so, leaving a permanent inability to uplift the arm or raise the elbow. The rectus muscle of the thigh is also a very unfavourable one for recovery, leaving a permanent inability to extend the leg upon the thigh, and rendering necessary a mechanical support to compensate for this inability. The muscles surrounding the hip-joint generally make a very favourable recovery, and those most useful muscles in progression, the psoas and iliacus, are seldom lost. In the leg, the muscles of the calf—the gastrocnemius and soleus—are always very slow to recover, and frequently fail to do so, thus causing a troublesome and incurable deformity of the foot—talipes calcaneus. In the leg it sometimes happens that all the muscles make a fair recovery, except the tibialis anticus, which alone remains paralysed, giving rise to an everted condition of the foot—talipes valgus.

As a general result, it seems that contraction at some of the joints involved almost invariably occurs ; we are therefore obliged to admit that whilst nature is a very good physician and does her best to aid in the recovery of muscular power, she is unmistakeably a bad surgeon, and does her worst in the production of various contractions and deformities. If this law were more generally known many contractions and deformities at the joints might be avoided. Cases are frequently brought to me in which the patients are making an excellent recovery from some paralytic affection, but little attention has been paid to the early stage of contraction which quickly attracts my attention. This

most frequently occurs at the ankle-joint from contraction of the Achilles tendon, as we generally describe it, although we know the structural changes really occur in the muscles of the calf. The effect of this contraction is to limit the power of flexing the foot at the ankle-joint, and if allowed to progress, the heel will become elevated and a condition of talipes equinus produced, with all its inconvenience in walking, if one foot only is affected.

If both feet should be affected, then the patient will be unable to stand until after tenotomy has been performed. If the contraction is detected in the early stage, I generally find it can be effectually overcome by a well-regulated course of massage, accompanied with passive movements ; these movements, however, require more special attention than is generally given to them. The reason of this contraction being overlooked in the early stage is, that there is nothing particular to direct attention to it, and also that the method of testing the flexion power of the foot at the ankle-joint is perhaps hardly studied with sufficient care. This should be done in the following manner. First, the leg must be placed in a fully extended position, and the knee-joint lightly held either by the patient or surgeon to prevent any flexion at this joint, as I need hardly say this would destroy the test by relaxing the heads of the gastrocnemius muscle attached to the condyles of the femur. I prefer the patient to be sitting on a chair, and resting the foot on another chair placed opposite, and of the same height. Then the surgeon, lightly grasping the knee with the left hand so as to keep the leg fully extended, may with his right hand try to flex the foot at the ankle-joint. In-

stead of using the hand, however, it is a good plan to place a piece of wood or a book against the sole of the foot, and by a little pressure try to flex the foot.

In slight cases it will be found that the foot can be flexed barely up to a right angle with the leg, and then the Achilles tendon becomes very tense. This is commonly spoken of as a *right-angled contraction of the Achilles tendon*, and gives rise to more inconvenience in walking, and in active exercise, than might be supposed, but it can generally be overcome by massage and passive movement. In a more severe case it will be found that the foot cannot be flexed up to, or nearly so far as, the right angle—probably 10° or more short of the right angle,—the foot forming an obtuse angle with the leg at 100° . In such a case I should at once advise tenotomy, as there is no probability of overcoming this degree of contraction by massage and passive movements.

The only alternative is the tedious and uncertain process of gradual mechanical extension, carried out by means of a Scarpa's shoe, with rack-and-pinion movement at the ankle-joint, to be worn night and day, for many months—at least six—the patient using crutches, and not allowed to touch the ground with his foot during the whole time. The treatment by tenotomy would average from six to eight weeks, and from its certainty is in every way to be preferred. Naturally the foot should be capable of being flexed upon the leg from the ankle-joint to 18° over the right angle, *i.e.*, to an angle of 72° , this degree of flexion being necessary for good walking purposes, and in young people this will, as a rule, be found to exist. In adults also it generally exists, especially in ladies. Less than 15° of flexion beyond

the right angle, or 75° , will not suffice for good walking purposes in the adult, and with a limited degree of flexion movement various troubles arise, but these are not connected with our present subject.

For the purpose of measuring accurately the angle of flexion, I use an instrument well known as the "engineer's rule," with a water-level on the lever held horizontally, and the degrees through half a circle marked off in 5° and 10° . (*a*) For rough use I employ a measure fixed at 72° , which at once shows the patient how much short of the natural angle of flexion the foot may be. The measure should be taken along the outer border of the foot, as this is a tolerably straight line, whilst the arched border on the inner side renders the measure less apparent.

The contractions resulting from paralysis we are called upon to treat surgically, most frequently occur in the lower extremities, and the great majority result from infantile paralysis, affecting either one, or both legs—*i.e.*, in the form of hemiplegia or paraplegia.

In infantile paralysis we have two distinct classes—*viz.*, those characterised by rigidity of the muscles, and those in which the muscles are flaccid. These two classes differ widely in their pathological and clinical history, and equally therefore in their prognosis and treatment. In their medical aspect they have been fully described by my able colleague, Dr. Gowers, in the lectures delivered by him in this hospital.

A few surgical points in reference to these, however, I shall here allude to. When one leg only is affected, and the foot contracted, although the awkwardness, and

(*a*) In an improved form this has been made for me by Elliott Bros., of St. Martin's Lane.

inconvenience in walking may be considerable, I have known surgical interference to be strongly opposed on the ground that the contracted foot is a firmer support and more useful, the contraction possibly compensating for some degree of shortening, than it would be after tenotomy, and the use of a raised boot. But I believe it to be better for the patient not to be allowed to walk on the toes with a raised heel, and to have the sole of the foot brought firmly in contact with the ground by tenotomy, even if a boot raised half an inch or more should be required.

When both legs are affected and the feet contracted, the patient is totally unable either to stand or walk, and objection is at the present time seldom raised to the combination of surgical and mechanical treatment by which these patients are generally enabled to walk fairly well. In bygone times I have known the strongest opposition raised to any surgical treatment in these cases, on the ground of the paralytic origin of the affection and the persistence of the central lesion in the spinal cord, or at the base of the brain, which would prevent any permanent benefit resulting from the operation, and certainly lead to recontraction of the divided tendons. Those who hold this view would continue to attack the central lesion by counter-irritation to the spine externally, and by saturating the patients with powerful drugs, such as mercury, arsenic, iodide of potassium, &c.

There is no doubt as to the persistence of the spinal cord lesion in these cases, but when this is no longer in an active stage of increase, and has remained so for some months or years, the late effects are entirely beyond the influence of the central lesion, which may

be considered not only to be in a stage of arrest, but also in a stage of repair ; and the indication of the reparative stage is to be found in the partial, or in some cases complete, return of voluntary muscular power.

My experience is that operative and mechanical treatment is of the greatest advantage in these cases, as we are enabled to make patients walk with ease and comfort who have not walked for many years ; though necessarily with a restricted gait, and generally with some mechanical assistance.

With regard to the liability to recontraction in the divided tendons, this undoubtedly exists in the congenital, and in all the other forms of contraction, and is probably somewhat greater in the paralytic class, but with attention to massage, passive movements, and galvanism, this recontraction may generally be prevented ; if it should occur, a second operation may be resorted to with every prospect of success.

The belief that dividing tendons must still further weaken the limbs is also frequently urged against any operative treatment in cases of paralytic origin. The fact that contracted muscles are strengthened by division of their tendons was never recognised by the older surgeons, and indeed is not universally recognised at the present time ; but the explanation will be obvious when I mention that by the increased length of the tendon gained by the insertion of new tendon, varying from half an inch to an inch and a half, as it may be required between the divided extremities of the old tendon, movement at the joint involved—say, the ankle-joint—is at once permitted ; whilst in the contracted condition of the muscles no movement at the joint could take place. The effect of the joint movement is to

increase muscular development, and except in extreme cases of complete degeneration of the muscular fibres, the muscular structure always perceptibly increases in bulk. A good illustration of this fact is seen by comparing the leg of an adult born club-footed and never operated upon, with the leg of an adult born club-footed who had been operated upon and well cured in childhood.

I now exhibit to you plaster-of-Paris casts of two such cases, and it will be seen that the calves in the case which had been operated upon and cured, measure two inches more in circumference than the calf of the club-footed adult who had not been operated upon. These cases are given in detail in my work on Club-foot, second edition.

CASE 13.—*Severe case of congenital talipes varus of the right foot in the adult, which had not been operated on, or otherwise treated.*—Mr. B—, æt. 26, a tall and very muscular man. The leg on the affected side, below knee, appeared to be very small—a withered limb, as it might be described, and the calf measured only $11\frac{1}{2}$ inches in circumference, and was much higher than natural. I operated upon this gentleman on May 29th, 1854, and the deformity was cured in little more than a year, but the movement at the ankle-joint remained very limited. The last report published was on May 29th, 1856, when improvement in every respect was maintained, and it is also stated that the calf had increased $1\frac{3}{4}$ in. in circumference.

CASE 14.—*Severe case of relapsed congenital varus of both feet after two operations.*—Master H. A.—, æt. 10. I operated on this patient on Aug. 12th, 1852 but the measurement of the calves at that time

is not stated. On Jan. 15th, 1855, nearly two years and a half after the operation, the calves are stated to have measured $10\frac{1}{2}$ in. in circumference, no doubt a considerable increase since the operation. On June 6th, 1860, I had the opportunity of examining this patient again. He was then over eighteen years of age. The feet remained perfect in form, with free motion at the ankle-joints, and the calves in circumference measured $13\frac{1}{2}$ in.—*i.e.*, 2 in. more than the calf of the gentleman aged twenty-six years, who had not been operated upon. From this illustration, and many more might be given, there can be no doubt that contracted muscles are strengthened, and the muscular development increased by division of their tendons.

We are not, therefore, to be deterred from dividing tendons, even in paralytic deformities, and we know that some of the most brilliant results have been obtained in cases of paraplegia, either infantile or adult, in which the patients have been unable to stand or walk for many years. Several good illustrations of the advantages derived from treatment in these cases are to be seen amongst the patients waiting for examination in the adjoining room. In cases of severe and long-standing paralysis, however, extra care is required to obtain a strong union of the divided tendon, and sufficient without excessive elongation.

All the contractions which occur during the progress of paralytic affections towards recovery are to be treated surgically on the same general principles—*viz.*: (1) By the subcutaneous division of all the contracted tendons; (2) by gradual mechanical extension, in order to ensure the formation of a sufficient length of new tendon between the divided extremities of the old

tendon, and at the same time guard against excessive elongation ; and also to stretch the deep ligaments and other structures that cannot be divided ; (3) by physiological means to promote the restoration of muscular power—viz., massage and passive movements, together with galvanism to special muscles when required ; (4) by mechanical supports adapted to the requirements of the case, so that by compensating for the paralysis, more or less complete, of particular muscles or groups of muscles, the patient may be enabled to walk, a great gain to those who have been allowed to reach adult life without having walked from childhood. In reference to these different principles I have but few remarks to make in their application to the particular class of cases we are now considering.

With regard to *tenotomy*, in dividing the Achilles tendon we always enter the point of the knife obliquely downwards, a quarter of an inch from the margin of the tendon, and divide from within outwards towards the skin ; but in one class of paralytic deformities—viz., those with rigid muscles (“spasmodic rigidity” or “spastic contraction” as it is called)—there is a special danger in this operation of a large open wound being made, instead of a subcutaneous puncture. The assistant who has charge of the foot should be aware that in these cases the anterior muscles are sometimes thrown into violent spasmodic contractions as soon as the tendon is divided, and if he does not control this violent flexion of the foot, the tenotomy knife must pass through and completely divide the skin, especially if the Achilles tendon should be prominent and thinly covered, as it generally is in these cases. Before the tendon is completely divided the assistant should begin

to relax the tension, and instantaneously, as the division is completed, extend the foot and approximate the divided extremities of the tendon. In this position the foot should then be bandaged, and a flexible metal splint applied.

This accident happened once in my practice, when dividing the Achilles tendon in a young lady with spastic contraction, although I had especially cautioned the surgeon assisting me as to its liability in this case. Fortunately, however, the case did well. In another case a colleague of mine had the greatest difficulty in preventing it whilst I was operating, so strong was the spasmodic action of the anterior muscles. The liability to this accident should be borne in mind.

The tendo Achillis is recommended by some surgeons to be divided by passing the knife flatways between the tendon and skin, and then cutting through the tendon from behind forwards. The Edinburgh school generally adopt this method, and it has been recommended by Liston, Syme, and Sir William Fergusson ; but in this method of operating the posterior tibial artery may be punctured by the point of the knife dipping too suddenly and too deeply after the tendon has given way, an accident I once saw occur in a boy twelve years of age, but the hæmorrhage was controlled by pressure, and the case did well.

After-treatment.—I need hardly remind you that within the last few months there has been a good deal of discussion as to the *rate of extension* after tenotomy—*i.e.*, whether it should be *immediate*, *rapid*, or *gradual*. In the particular class of cases we are now speaking of—*i.e.*, paralytic deformities—I would strongly advise you against *immediate extension*, or

what is described as *immediate reduction* of the deformity. No doubt some successful cases have occurred, but I have seen many unsuccessful — *i.e.*, cases of elongated and very feeble union, practically amounting almost to non-union, and the patients damaged for life, as excessive elongation produces the incurable condition of talipes calcaneus.

The object of *gradual extension* is not to elongate or stretch the new material, uniting the divided extremities of the tendon, as is generally supposed ; but to regulate the length of new material, or, as it may be called, the new tendon, whilst we have the opportunity of so doing, and the rate at which this is to be accomplished must have reference to the activity of the reparative process, and to the length of new tendon required. (a) In the Achilles tendon this can be easily observed, and I always examine it carefully twice a week. In well-nourished infants the full length required in the divided Achilles tendon should, according to my observation, be obtained in a fortnight, if practicable ; in a well-nourished leg in an adult it should be obtained in from three to four weeks ; but in atrophied paralytic limbs it should not be obtained in less than from four to six weeks. The extension described as *rapid*—*i.e.*, gaining the length required at intervals of a week—is more rational, the foot being put up either in a plaster-of-Paris bandage or any immobility splint, provided this is removed at least once a week, or at intervals of four days, during the first three or four weeks ; but I prefer the gradual exten-

(a) This subject is well illustrated in the plates in my work "On the Reparative Process in Human Tendons." London : Churchill. 1860. And also in my book on "Club-foot," 2 Ed. Churchill. 1873.

sion by means of my varus splint for infants, or a Scarpa's shoe with rack-and-pinion movements, which can be regulated as frequently as may be required.

In contractions of the knee- and hip-joints the extension can often be made satisfactorily by means of the ordinary weight extension apparatus. With regard to *the third principle of treatment—i.e.*, by physiological means to promote the restoration of muscular power, —there can be no doubt that the improved system of massage, now so ably taught in some schools of instruction, and by professors who have established this system upon a scientific basis, is of the utmost value ; and in many cases this may be still further assisted by a well-regulated course of galvanic treatment. In reference to *the fourth principle of treatment—viz.*, the employment of mechanical supports, so constructed as to compensate for the more or less complete paralysis of certain muscles, which in severe cases often remain as a permanent defect, there can be no doubt as to the necessity of employing such mechanical assistance, and the instruments now in use are constructed upon the most scientific principles, with various ingenious contrivances adapted to the special requirements of each case, and a variety of these appliances I now exhibit to you.

There can be no doubt that by a combination of these different principles of treatment results are now obtained in the class of paralytic deformities which were totally unknown to, and not within the reach of our predecessors.

Before leaving the subject of tenotomy and its results I would refer to one point which has long attracted my attention—viz., the fact that

after tenotomy in cases of paralysis in which the feet are always cold and cannot be warmed by artificial means, a very marked increase of temperature rapidly follows the operation of tenotomy, and the feet remain warm.

The mother of a boy, æt. 12, upon whom I operated six weeks ago at 9 a.m.—dividing the Achilles tendon for paralytic contraction of the foot,—told me that she observed an increase of temperature the same evening ; and this has been maintained. Only yesterday I operated upon the other foot, which was also paralysed and contracted, and a marked difference in the temperature of the two feet was observable, the one about to be operated upon having remained cold. It is of common occurrence at the Orthopædic Hospital for the mother of a child which had been recently operated upon for paralytic contraction to draw attention to the fact that the child's foot became and has remained warm since the operation, whilst she had been unable to keep the foot warm by any extra clothing or other means before the operation.

As to the explanation of this increase of temperature after tenotomy, it seemed to me that it might be due to a certain amount of muscular action taking place in the muscles not contracted, after the tendons of the contracted muscles had been divided. But Dr. Brown-Séquard, to whom I mentioned the occurrence of this event at the time he was connected with this hospital as one of the physicians, said that he believed it to be due to a direct reflex action of the spinal cord, and that a local increase of temperature probably followed all surgical operations, but it would be most observable in cases of paralysis.

In the surgical treatment of contractions occurring in cases of paralysis, it is necessary to bear in mind that these are essentially of muscular origin, and are due either to active muscular contraction, or adapted shortening of an atrophic and passive character. There are no adhesions, either intra-capsular or extra-capsular, in paralytic contractions. The deep ligaments and bands of fascia are, however, subject to adapted structural shortening, in those cases in which the limb has been long retained in a contracted position; whilst an atrophic and elongated condition of the capsular ligament of the shoulder or hip-joint constantly occurs in other cases. If there is any law firmly established by long experience in the surgical treatment of contracted joints in deformities due to paralysis, it is, *never attempt to overcome muscular contraction by forcible extension*. By subcutaneous tenotomy we can at once remove all, or nearly all, the muscular contraction without the least possible risk, and gradual mechanical extension will overcome the other obstacles.

I wish more especially to draw your attention to this law, as I have frequently seen cases in which serious injury has resulted, such as fracture of the femur, or separation of the lower epiphysis in a case of knee-joint contraction; laceration of the skin when this is in an atrophic condition, as in the so-called *glossy skin* occasionally met with in some cases of paralysis; a liability to dislocation of the hip, &c., when the surgeon has employed forcible extension, instead of tenotomy and gradual extension.

In addition to the contractions and deformities chiefly affecting the lower extremities in paralytic

cases which we have been considering, there are other deformities affecting the spine and the pelvis, as well as also the occasional displacement from ligamentous relaxation, and in some cases the complete dislocation of the head of the femur on the dorsum ilii. These results occur only in one class of cases—viz., the most severe form of infantile paralysis, in which both legs, both arms, and the muscles of the trunk are affected. The natural recovery in these cases, which we have not time to discuss in the present lecture, is very slow, partial, and incomplete, the permanent defect remaining through life, being considerable ; and, moreover, the complications of severe spinal curvature, pelvic tilting, and partial or complete luxation of the hip-joint seriously interfere with any advantage gained by surgical or mechanical treatment.

In one case of this extremely severe form of infantile paralysis, the complete luxation of the head of the femur was verified by a post-mortem examination, the head of the femur being found displaced upwards and backwards. The patient, a young lady, æt. 18., when she came under my care, had never walked since childhood, and had only been able to get about the room with assistance. In addition to contractions at both hip-joints, both knees, and both feet, luxation of the hip-joint was found to have occurred, the head of the femur being displaced upwards, and backwards. After treatment, she was enabled to walk fairly well with a raised boot and steel support, as well as a leather pelvic belt with straps to retain the femur in position, but there had been for many years great difficulty in feeding her, the stomach frequently rejecting food, and she died suddenly from syncope.

At the post-mortem examination, the stomach was found to be enormously dilated, and its walls extremely thin and atrophied. This condition, I have no doubt, frequently exists in these cases.

I have known two other deaths take place under similar circumstances. In one of these, a young gentleman, *æt.* 20, with contractions at both hips, knees, and feet, who had not walked from childhood, my colleague, Mr. Lockwood, carefully examined with me. There was no doubt as to the complete dorsal luxation of the head of the femur, due to an elongated and atrophied condition of the capsular ligaments. The head of the femur could be easily restored to the acetabulum by the ordinary movement of manipulation, but it quickly become luxated again. He died suddenly from syncope during one of my visits. No post-mortem examination was allowed, but there had been great difficulty in feeding him for some years, and the dilated and atrophic condition of the stomach probably existed.

This class of cases is especially worthy of our consideration, as treatment at an early period, so as to permit locomotion, even with the assistance of mechanical supports, would materially assist in maintaining the general health. The treatment of cases of contraction and deformity due to paralysis, whether in its infantile or adult form, should receive more attention than has generally been given to this class of cases.

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